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INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

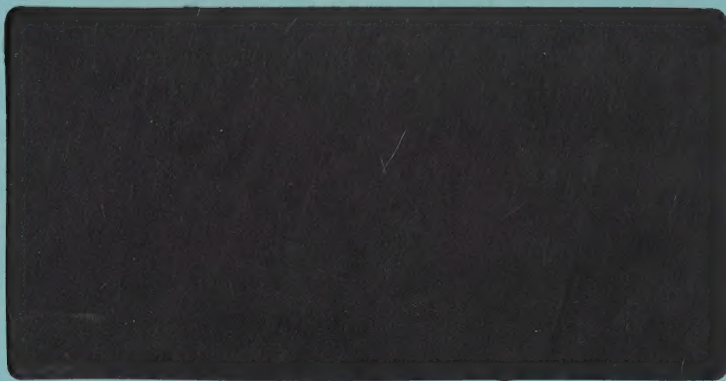
LCD-A SERIES

This manual applies to units
bearing serial no. prefixes A-E



LAMBDA ELECTRONICS

MELVILLE, L. I., N. Y.



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FOR
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This manual provides instructions intended for the operation of Lambda power supplies and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to all LCD-A models unless otherwise specified.

LAMBDA ELECTRONICS

MELVILLE, L.I., N.Y.
MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

IM-LCD-A

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SPECIFICATIONS AND FEATURES

Specifications apply for all models

DC OUTPUT--Voltage regulated for line and load. See table I for voltage and current ratings. Dual outputs are independent of one another. Both outputs are floating.

TABLE I
VOLTAGE AND CURRENT

RANGES

Model	VOLTAGE RANGE (EACH SIDE)	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE			
		40°C	50°C	60°C	71°C
LCD-A-11	0-7 VDC	1.0	0.9	0.7	0.5
	0-7 VDC	1.0	0.9	0.7	0.5
LCD-A-12	0-18 VDC	0.5	0.45	0.40	0.30
	0-7 VDC	1.0	0.9	0.7	0.5
LCD-A-13	0-32 VDC	0.35	0.30	0.25	0.20
	0-7 VDC	1.0	0.9	0.7	0.5
LCD-A-22	0-18 VDC	0.5	0.45	0.40	0.30
	0-18 VDC	0.5	0.45	0.40	0.30
LCD-A-23	0-32 VDC	0.35	0.30	0.25	0.20
	0-18 VDC	0.5	0.45	0.40	0.30
LCD-A-33	0-32 VDC	0.35	0.30	0.25	0.20
	0-32 VDC	0.35	0.30	0.25	0.20
LCD-A-44	0-60 VDC	0.2	0.18	0.14	0.12
	0-60 VDC	0.2	0.18	0.14	0.12
LCD-A-55	0-120 VDC	0.075	0.075	0.075	0.060
	0-120 VDC	0.075	0.075	0.075	0.060

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

REGULATED VOLTAGE OUTPUT

Regulation (line) 0.01 percent plus 1.0 millivolt for input variations from 105-132 or 132-105 volts AC

Regulation (load) 0.01 percent plus 1.0 millivolt for load variations from no load to full load or full load to no load

Remote Programming

External Resistor	Nominal 1000 ohms/volt output
Programming Voltage	One-to-one voltage change
Ripple and Noise	250 microvolts rms; 1 millivolt peak to peak with 57-63 Hz input
Temperature Coefficient	Output change in voltage 0.01% + 0.3 mv/°C using an external programming resistor, less than 0.015% + 0.3 mv/°C with internal resistor
Remote Sensing	Provision is made for remote sensing to eliminate effect of power output lead resistance DC regulation.

AC INPUT -- 105-132, 205-265 or 187-242 ("V" option) volts AC at 47-440 Hz.
Maximum input power*: 55 watts. Ratings apply for 57-440 Hz.;
at 47-57 Hz input derate 40°C current rating by 10%.

*With output loaded to full 40°C rating and input voltage
132 volts AC, 60 Hz.

OVERLOAD PROTECTION

Electrical

External	Automatic electronic current limiting circuit, limits output current to a preset value less than 140% of 40°C current rating. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.
Internal	Fuse F1 provides protection against internal circuit failure in conjunction with overvoltage protector option.

INPUT AND OUTPUT CONNECTIONS--Terminal block on rear of chassis.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE--Continuous duty from -20°C to +71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE-
(non-operating) -55°C to 85°C

CONTROLS

DC output control	Voltage adjust controls permit independent adjustment of DC output.
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PHYSICAL DATA

Size 3-3/16" X 3-3/4" X 6-1/2"

Weight 5 lbs. net; 6 lbs. shipping wt.

Finish Grey, FED. STD. 595, No. 26081

MOUNTING - Three surfaces, each with tapped mounting holes, can be utilized for mounting this unit. All LCD-A power supplies can be mounted with Top, Front, or Right Side facing up. Top, Front, or Right Side must be in a horizontal plane. Refer to Figure 13 for mounting details.

"V" OPTION - Standard LCD-A power supplies can be obtained for 205-265 or 187-242 VAC, 47-440 Hz input. See nameplate for AC input rating. See schematic diagram for rewiring of AC input. With 47-57 Hz input, derate 40°C current rating by 10%.

ACCESSORIES

Rack Adapter Rack Adapters LRA-8, LRA-10, LRA-11, LRA-12, and LRA-13 with or without chassis slides are available.

Overvoltage Protector Externally mounted, Overvoltage Protectors LH-OV-4, LH-OV-5 and LH-OV-6 are available for use with Lambda LCD-A power supplies.

Control Panel All LCD-A power supplies may be obtained with a Systems Power Control Panel, SP-3 or SP-5. This unit, mounted on rack adapters LRA-8, LRA-10 or LRA-11 and used with a Standard Cable or Auxiliary Cable, provides an on-off switch, voltage control and pilot light. A single SP controls both master (M) and slave (S) units of the power supply.

Metering Panel A Systems Metering Panel, SMP-3 or SMP-5, may be used in conjunction with the LCD-A power supplies. The panel, mounted in rack adapter LRA-8, LRA-10 or LRA-11 and used with a Standard Cable, contains a voltmeter and an ammeter, each with three ranges and push button selector switch. The selector switch allows monitoring of the voltage and current of any of up to 16 outputs.

THEORY OF OPERATION

GENERAL

The text in this section refers to circuit designations for the "M" unit of the LCD-A power supply. However, the discussion is equally applicable to the "S" unit which has electrically identical components in the 100 series except for CR112, which is used in the "S" unit only.

The Lambda power supply consists of an AC input circuit and transformer; a bias supply consisting of an auxiliary rectifier and filter, and preregulator*; a main regulator circuit consisting of the main rectifier and a voltage comparator*, an amplifier*, current and voltage sensing networks and a voltage reference circuit*.

*This circuit element is part of integrated circuit (IC1) in the supply.

The circuit arrangement is shown in block diagram form, Figure 11. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Single phase input power is applied to transformer T1 through the input circuit. Transformer T1 supplies secondary power for both "M" and "S" units.

The main rectifier, a full wave bridge rectifier, provides the power which is filtered by capacitor C6 and then regulated via a series regulator and delivered to the output. Half-wave auxiliary rectifier CR1 provides voltage filtered by capacitor C1 for the preregulator located in IC1. The reference element, powered by the preregulator, provides a reference voltage for the current comparator and the voltage comparator.

Constant voltage circuit operation is determined by changes in the load which cause a change in one input to the voltage comparator. A second input to the comparator is a reference voltage that is developed by a constant current of 1 milliamperes flowing in divider element R8. The comparator compares the output voltage change with the reference voltage resulting in an error signal at the output of the comparator.

In constant voltage operation the voltage across R7 is less than the preset voltage across R6, causing the current comparator to be at cut off. If the load current decreases, causing a rise in output voltage, the voltage comparator conducts less and more current flows through the OR gate. This action causes the amplifier to conduct more heavily, reducing drive current to the base of driver Q1, causing the series regulator impedance to increase and the output voltage to decrease accordingly.

Current limit circuit operation is determined by changes in the load. The current comparator samples load current through current sensing resistor R7. When the voltage drop across R7 increases to the preset voltage reference determined by R6 and R9, the current comparator conducts. Thus, when the output current rating of the unit is exceeded, the current comparator conducts, decreasing the current through driver Q1, resulting in an increase of voltage across the series regulator and a decrease of the output voltage, effectively limiting the output current to a safe value. The current limit value is determined by fixed resistors R6, R9 and R7.

OPERATING INSTRUCTIONS

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature and will remain limited to less than 140% of 40°C rating.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying AC input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal blocks on the rear of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded (hot) lead to terminal 1.

The supply positive terminal is brought out to terminals 6 (M unit) and 14 (S unit). The supply negative terminal is brought out to terminals 4 (M unit) and 12 (S unit). Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 10. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections For Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Two-Wire Connection, Figure 3. The two-wire connection, with local sensing, is the connection suitable for applications with relatively constant load.

Four-Wire Connection, Figure 4. The four-wire connection with remote sensing, provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5mf, elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at 1000 ohms/volt and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply.

The programming supply must have a reverse current capability of 1.5 ma. minimum.

Alternatively, when supplies with less than 1.5 ma. reverse current capability are used, a resistor capable of drawing 1.5 ma. at the minimum programming voltage must be connected across the output terminals of the supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation

The voltage capability of LCD-A power supplies can be extended by series operation. A maximum of 250 volts can be connected between either the +DC or -DC terminal and chassis ground, with a maximum voltage capability of 240 volts possible for model LCD-A-55. If a common load is used, the maximum current rating of the unit with the lower current rating must not be exceeded.

Figure 7 shows connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output, and where the S unit does not track the M unit.

Units M and S are shown connected for auto-series operation in figure 8 and 9. Figure 8 shows the series connection diagram which would be suitable for use in most applications where tracking is desired. Using externally connected meters, first set the S unit output voltage adjust control for zero output, then set M unit output voltage adjust control for desired output voltage. Readjust S unit output voltage to agree with the output voltage of the M unit. The S unit will track any change in M unit output voltage made with the M unit voltage adjust control.

Voltage divider R_M must be used during auto-series operation. Variations of R_M according to the desired output voltage of the supply* may be found by applying the following formula:

$$R_M = \frac{E_{out}}{I_{div}}$$

where E_{out} is the desired supply output voltage and I_{div} is the divider current. I_{div} may vary between a minimum and maximum value of one and two milliamperes respectively.

* On hybrid power supplies (LCD-A-12, -13 -23) desired master output voltage must never exceed the slave maximum output voltage rating.

Figure 9 shows the series connection diagram suitable for applications where more precise voltage tracking due to temperature changes is required.

Resistor R_{BAL} should be a one-watt, 1 - 2 kilohm resistor. This value would permit wide-range compensation for manufacturing differences inherent in the components used in each unit. Resistors R_S and R_M function in the voltage sensing circuits of both units, enabling the S unit to reference its output voltage to that of the M unit. Select R_M and R_S on the basis of 500 ohm to 1000 ohm per volt of M unit output voltage. R_M must equal R_S .

Capacitor C, used to eliminate stray AC pickup, is rated at 2.5 mf, 200V for models LCD-A-11 thru LCD-A-44. On model LCD-A-55, C is rated at 1.4 mf 400V.

Connections For Parallel Operation

The current capability of LCD-A power supplies can be extended by parallel operation of LCD-A power supplies of equal* voltage capacities. Units "M" and "S" are shown connected for parallel operation in figure 10. One power supply designated the "master" or M unit controls its own output as well as the output of the second power supply, designated the "slave" or S unit.

* For applications using supplies of unequal voltage ratings, consult factory for details of operation.

Unit S operates to regulate its current in a ratio to that of the M unit by comparing the current in its internal sampling resistor with that current sampled by the master internal sampling resistor.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Fuse Shutdown

Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative. When the LCD-A supply is used with the overvoltage protector option, fuse F1 will provide load protection against internal component failure.

MAINTENANCE

GENERAL

This section describes trouble analysis routine, replacement procedures and test procedures that are useful for servicing the Lambda LCD-A power supply. A trouble chart is provided as an aid for the trouble-shooter. The text of the trouble chart refers to component designations of unit M of the LCD-A supply, but it is equally applicable for unit S which has identical components designated in the 100 series. Refer to the section on specifications and features for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before trouble shooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumper and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 11, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an instrument that has a highly limited current capability. Observe proper polarity to avoid error in measurement. The forward transistor resistance is low but never zero; backward resistance is always higher than the forward resistance.

For good transistors, the forward resistance for any junction is always greater than zero.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on before checking for additional defective components could damage the replaced component.

When soldering semi-conductor devices, wherever possible, hold the lead being soldered with a pair of pliers placed between the component and the solder joint to provide an effective heat sink.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder it is a good contact. Do not attempt to cover with solder.
2. Voltage measurements can be made from either side of the board. Use a needlepoint probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to the measuring instrument.
3. Wherever possible use a heat sink when soldering transistors.
4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.
5. When unsoldering components from the board, never pry or force loose the part; unsolder the component by using the wicking process described below:
 - (a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.
 - (b) Dip the wick in liquid rosin flux.
 - (c) Place the wick onto the soldered connection and apply soldering iron onto the wick.
 - (d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes, and is used along with the schematic diagram. When troubleshooting the S unit, add 100 to the component designations in the trouble chart.

The operating conditions assumed for the trouble chart are as follows:

- (a) AC power of proper voltage and frequency is preset at input terminals.
- (b) Either positive or negative terminal is connected to chassis ground.
- (c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

TROUBLE SHOOTING CHART

<u>Symptom</u>	<u>Probable Cause</u>	<u>Remedy</u>
1. Zero volts DC output	OUTPUT VOLTAGE control turned fully CCW	Check OUTPUT VOLTAGE control for proper setting and correct as necessary
	Short circuit across output of supply	Check load and load connections, correct as necessary
	F1 open	Replace F1; if it blows immediately, check for shorted diode CR7 transistors Q1, Q2 and capacitor C7, replace as necessary
	Series regulator section open	Check Q1 and Q2 for open, replace as necessary
	Open CR6 or, as applicable, CR15	Check CR6 or CR15 for open, replace as necessary
	Open CR8, CR9 or R1	Check CR8, CR9 and R1 for open, replace as necessary
	Current sensing resistor open	Check R7 for open, R6 for short; R9 for open; replace as necessary
	Aux. rectifier CR1 open	Check CR1 for open; replace as necessary
2. Unable to adjust output voltage	On S unit, jumper between 9 and 10 open	Check S unit jumper connection to terminals 9 & 10 and correct as necessary
	Damaged OUTPUT VOLTAGE control	Check R8 for short and/or open; replace as necessary
3. High ripple at line frequency or twice line frequency and unregulated DC output	Series regulator transistors shorted	Check Q1 and Q2 for short and replace as necessary

TROUBLE SHOOTING CHART (cont'd)

<u>Symptom</u>	<u>Probable Cause</u>	<u>Remedy</u>
(Step 3 cont'd)	Defective main rectifier causes ripple at twice line frequency	Check for open and/or short CR2, CR3, CR4 and CR5
4. Same as 3, except intermittent	Foreign matter fallen into unit	Check for loose bench hardware and wire clippings that may have fallen through cover.
5. High ripple at frequency other than line or twice line frequency	Oscillation due to defective component in filter network	Check for open C7, C2 and check for open and/or short in C11 and R2. Replace defective component
6. Large spikes at output	Capacitor C5 open	Replace C5, as necessary

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 12. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC VTVM (John Fluke Model 801H or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the load to no-load condition. Long load leads should be a twisted pair to minimize AC pickup.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power-supply line regulation accuracy on the VTVM differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office, where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. The model number and serial number of power supply and purchase date.
2. Lambda part number.
3. Description of part together with circuit designation.
4. If part is not an electronic part, or is not listed, provide a description, function, and location of the part.

PARTS LIST

The electrical parts located on Lambda models LCD-A-11 — LCD-A-55 are listed here. Parts for units M and S are listed separately by unit. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common-parts listing. In addition there are separate listings of parts for the V option and SP-3, SP-5, SMP-3, SMP-5 and LHOV accessories.

COMMON PARTS

MODELS LCD-A-11 — LCD-A-55

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., elect., 40 mf -10 + 75%, 25 vdc	CBP-40-036
C2	Cap., mylar, 0.047 mf ±10%, 80 vdc	CGL-47-013
C3, C4 C9	Not assigned	
C16	Cap., mylar, 1 mf ±10%, 200 vdc	CGN-10-005
C19	Cap., mylar, 0.1 mf ±10%, 80 vdc	CGM-10-006
CR1, CR9, CR10	Cap., mylar, 0.001 mf ±10%, 200 vdc	CGK-10-004
CR11*	Rectifier	FBL-00-030
CR12	Rectifier	FBM-Z119
CR13	Not assigned	
CR14, CR16 thru CR21	Same as CR1	
CR22**	Not assigned	
R9	Rectifier, zener diode	FBM-Z139
R10+	Res., film, 10,000 ohms ±1%, 1/4 w	DCT-10-047
R11	Res., comp., 36 megohms ±5%, 1/4 w	DCB-3665
R12	Not assigned	
XF1	Res., comp., 68,000 ohms ±10%, 1/4 w	DCB-6831
*	Fuseholder	HRM-00-016
+	On units with serial no. prefix A, CR11 is FBL-00-030.	
**	On units with serial no. prefixes A & B, R10 is 68 megohms ±10%, DCB-6861.	
	CR22 not used on units with serial no. prefixes A-D.	

UNIQUE PARTS

MODEL LCD-A-11 UNIT M

C5	Cap., mylar, 0.068 mf ±10%, 200 vdc	CGL-68-003
C6	Cap., elect., 700 mf -10 + 100%, 20 vdc	CBR-70-071
C7	Cap., elect., 100 mf -10 + 100%, 30 vdc	CBR-10-072

UNIQUE PARTS (Cont)

MODEL LCD-A-11 UNIT M (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C11	Cap., cermic, 680 pf ±10%, 300 vdc	CCJ-68-006
C15	Cap., mylar, 0.01 mf ±10%, 200 vdc	CGL-10-002
CR2 thru CR5	Rectifier	FBL-00-063
CR6	Not assigned	
CR7, CR8	Rectifier	FBL-00-030
CR15	Rectifier	FBL-00-047
F1	Fuse, 3 amperes	FFR-03-000
IC1*	Integrated circuit	FBT-00-030
Q1	Transistor, NPN	FBN-L113
Q2	Transistor, NPN	FBN-36485
R1	Res., film, 8,660 ohms ±1%, 1/4 w	DCS-87-071
R2	Res., comp., 150 ohms ±10%, 1/4 w	DCB-1511
R3	Res., comp., 1,500 ohms ±10%, 1/2 w	DEB-1521
R4	Res., ww., 1,000 ohms ±3%, 2 w	DFS-10-029
R5	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R6	Res., film, 357 ohms ±1%, 1/4 w	DCR-36-043
R7	Res., ww., 0.3 ohms ±5%, 3 w	DFM-30-053
R8	Res., var., ww or cermet, 10,000 ohms ±10%, 3/4 w	DNT-10-045
T1	Transformer	ABA-CDA-11A
*	On units with serial no. prefixes A & B, IC1 is FBT-00-002.	

MODEL LCD-A-12 UNIT M

C5	Cap., mylar, 0.068 mf ±10%, 200 vdc	CGL-68-003
C6	Cap., elect., 350 mf -10 + 100%, 40 vdc	CBR-35-070
C7	Cap., elect., 70 mf -10 + 100%, 40 vdc	CBP-70-049
C11	Cap., mica, 1,000 pf ±5%, 500 vdc	CCK-10-002
C15	Cap., mylar, 0.01 mf ±10%, 200 vdc	CGL-10-002

UNIQUE PARTS (Cont)
MODEL LCD-A-12 UNIT M (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
CR2 thru CR8	Rectifier	FBL-00-030
CR15	Not assigned	
F1	Fuse, 1.5 amperes	FFR-01-500
IC1*	Integrated circuit	FBT-00-031
Q1	Transistor, NPN	FBN-L113
Q2	Transistor, NPN	FBN-36485
R1	Res., film, 8,660 ohms ±1%, 1/4 w	DCS-87-071
R2	Res., comp., 330 ohms ±10%, 1/4 w	DCB-3311
R3	Res., comp., 4,700 ohms ±10%, 1/2 w	DEB-4721
R4	Res., ww., 1,200 ohms ±3%, 3 w	DFS-12-016
R5	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R6	Res., film, 332 ohms ±1%, 1/4 w	DCR-33-042
R7	Res., ww., 0.56 ohms ±5%, 3 w	DFM-56-042
R8	Res., var., ww or cermet, 23,000 ohms ±10%, 3/4 w	DNT-23-072
T1	Transformer	ABA-CDA-12A
*	On units with serial no. prefixes A & B, IC1 is FBT-00-010.	

MODEL LCD-A-13 UNIT M

C5	Cap., mylar, 0.068 mf ±10%, 200 vdc	CGL-68-003
C6	Cap., elect., 250 mf -10 + 100%, 50 vdc	CBR-25-069
C7	Cap., elect., 40 mf -10 + 100%, 60 vdc	CBP-40-047
C11	Cap., mica, 680 pf ±10%, 300 vdc	CCJ-68-006
C15	Cap., mylar, 0.01 mf ±10%, 200 vdc	CGL-10-002
CR2 thru CR8	Rectifier	FBL-00-030
CR15	Not assigned	
F1	Fuse, 1.5 amperes	FFR-01-500
IC1*	Integrated circuit	FBT-00-030
Q1	Transistor, NPN	FBN-L109
Q2	Transistor, NPN	FBN-36220
R1	Res., film, 8,660 ohms ±1%, 1/4 w	DCS-87-071
R2	Res., comp., 330 ohms ±10%, 1/4 w	DCB-3311
R3	Res., comp., 10,000 ohms ±10%, 1/2 w	DEB-1031
R4	Res., ww., 2,500 ohms ±3%, 3 w	DFS-25-036
R5	Res., comp., 820 ohms ±10%, 1/4 w	DCB-8211
R6	Res., film, 374 ohms ±1%, 1/4 w	DCR-37-044
R7	Res., ww., 0.91 ohms ±2%, 3 w	DFM-91-060
R8	Res., var., cermet, 40,000 ohms ±10%, 3/4 w	DRT-40-009
T1	Transformer	ABA-CDA-13A
*	On units with serial no. prefixes A & B, IC1 is FBT-00-002.	

MODEL LCD-A-22 UNIT M

C5	Cap., mylar, 0.068 mf ±10%, 200 vdc	CGL-68-003
C6	Cap., elect., 350 mf -10 + 100%, 40 vdc	CBR-35-070

UNIQUE PARTS (Cont)
MODEL LCD-A-22 UNIT M (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C7	Cap., elect., 70 mf -10 + 100%, 40 vdc	CBP-70-049
C11	Cap., mica, 680 pf ±10%, 300 vdc	CCJ-68-006
C15	Cap., mylar, 0.01 mf ±10%, 200 vdc	CGL-10-002
CR2 thru CR8	Rectifier	FBL-00-030
CR15	Not assigned	
F1	Fuse, 1.5 amperes	FFR-01-500
IC1*	Integrated circuit	FBT-00-031
Q1	Transistor, NPN	FBN-L109
Q2	Transistor, NPN	FBN-36485
R1	Res., film, 8,660 ohms ±1%, 1/4 w	DCS-87-071
R2	Res., comp., 220 ohms ±10%, 1/4 w	DCB-2211
R3	Res., comp., 4,700 ohms ±10%, 1/2 w	DEB-4721
R4	Res., ww., 1,200 ohms ±3%, 3 w	DFS-12-016
R5	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R6	Res., film, 332 ohms ±1%, 1/4 w	DCR-33-042
R7	Res., ww., 0.56 ohms ±5%, 3 w	DFM-56-042
R8	Res., var., ww or cermet, 23,000 ohms ±10%, 3/4 w	DNT-23-072
T1	Transformer	ABA-CDA-22A
*	On units with serial no. prefixes A & B, IC1 is FBT-00-010.	

MODEL LCD-A-23 UNIT M

C5	Cap., mylar, 0.068 mf ±10%, 200 vdc	CGL-68-003
C6	Cap., elect., 250 mf -10% + 100%, 50 vdc	CBR-25-069
C7	Cap., elect., 40 mf -10 + 100%, 60 vdc	CBP-40-047
C11	Cap., mica, 680 pf ±10%, 300 vdc	CCJ-68-006
C15	Cap., mylar, 0.01 mf ±10%, 200 vdc	CGL-10-002
CR2 thru CR8	Rectifier	FBL-00-030
CR15	Not assigned	
F1	Fuse 1.5 amperes	FFR-01-500
IC1*	Integrated circuit	FBT-00-031
Q1	Transistor, NPN	FBN-L109
Q2	Transistor, NPN	FBN-36220
R1	Res., film, 8,660 ohms ±1%, 1/4 w	DCS-87-071
R2	Res., comp., 330 ohms ±10%, 1/4 w	DCB-3311
R3	Res., comp., 10,000 ohms ±10%, 1/2 w	DEB-1031
R4	Res., ww., 2,500 ohms ±3%, 3 w	DFS-25-036
R5	Res., comp., 820 ohms ±10%, 1/4 w	DCB-8211
R6	Res., film, 374 ohms ±1%, 1/4 w	DCR-37-044
R7	Res., ww., 0.91 ohms ±2%, 3 w	DFM-91-060
R8	Res., var., cermet, 40,000 ohms ±10%, 3/4 w	DRT-40-009
T1	Transformer	ABA-CDA-23A
*	On units with serial no. prefixes A & B, IC1 is FBT-00-010.	

UNIQUE PARTS (Cont)
MODEL LCD-A-33 UNIT M

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C5	Cap., mylar, 0.068 mf ±10%, 200 vdc	CGL-68-003
C6	Cap., elect., 250 mf -10 + 100%, 50 vdc	CBR-25-069
C7	Cap., elect., 40 mf -10 + 100%, 60 vdc	CBP-40-047
C11	Cap., cermet, 680 pf ±10%, 300 vdc	CCJ-68-006
C15	Cap., mylar, 0.01 mf ±10%, 200 vdc	CGL-10-002
CR2 thru CR8	Rectifier	FBL-00-030
CR15	Not assigned	
F1	Fuse, 1.5 amperes	FFR-01-500
IC1*	Integrated circuit	FBT-00-031
Q1	Transistor, NPN	FBN-L109
Q2	Transistor, NPN	FBN-36220
R1	Res., film, 8660 ohms ±1%, 1/4 w	DCS-87-071
R2	Res., comp., 330 ohms ±10%, 1/4 w	DCB-3311
R3	Res., comp., 10,000 ohms ±10%, 1/2 w	DEB-1031
R4	Res., ww., 2,500 ohms ±3%, 3 w	DFS-25-036
R5	Res., comp., 820 ohms ±10%, 1/4 w	DCB-8211
R6	Res., film, 374 ohms ±1%, 1/4 w	DCR-37-044
R7	Res., ww., 0.91 ohms ±2%, 3 w	DFM-91-060
R8	Res., var., cermet, 40,000 ohms ±10%, 3/4 w	DRT-40-009
T1	Transformer	ABA-CDA-33A
*	On units with serial no. prefixes A & B, IC1 is FBT-00-010.	

MODEL LCD-A-44 UNIT M

C5	Cap., mylar, 0.015 mf ±10%, 400 vdc	CGL-15-007
C6	Cap., elect., 88 mf -10 + 100%, 100 vdc	CBP-88-045
C7	Cap., elect., 12 mf -10 + 100%, 150 vdc	CBP-12-046
C11	Cap., cermet, 1000 pf ±5%, 500 vdc	CCK-10-002
C15	Cap., mylar, 0.01 mf ±10%, 200 vdc	CGL-10-002
CR2 thru CR8	Rectifier	FBL-00-036
CR15	Not assigned	
F1	Fuse, 0.75 amperes	FFR-00-750
IC1*	Integrated circuit	FBT-00-031
Q1	Transistor, NPN	FBN-L108
Q2	Transistor, NPN	FBN-36485
R1	Res., film, 8660 ohms ±1%, 1/4 w	DCS-87-071
R2*	Res., comp., 330 ohms ±10%, 1/4 w	DCB-3311
R3	Res., comp., 33,000 ohms ±10%, 1/2 w	DEB-3331
R4	Res., ww., 3,600 ohms ±3%, 3 w	DFS-36-050
R5	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711

UNIQUE PARTS (Cont)
MODEL LCD-A-44 UNIT M (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R6	Res., film, 357 ohms ±1%, 1/4 w	DCR-36-043
R7	Res., ww., 1.5 ohms ±2%, 3 w	DFN-15-072
R8	Res., var., cermet, 75,000 ohms ±10%, 3/4 w	DRT-75-010
T1	Transformer	ABA-CDA-44A
	*On unit S, R102 is comp., 220 ohms ± 10%, 1/4 w	
	+ On units with serial no. prefixes A & B, IC1 is FBT-00-010.	
		DCB-2211

MODEL LCD-A-55 UNIT M

C5	Cap., mylar, 0.015 mf ±10%, 400 vdc	CGL-15-007
C6	Cap., elect., 40 mf -10 + 100%, 250 vdc	CBP-40-044
C7	Cap., elect., 8 mf -10 + 100%, 200 vdc	CBN-80-030
C11	Cap., cermet, 680 pf ±10%, 300 vdc	CCJ-68-006
C15	Cap., mylar, 0.0022 mf ±10%, 400 vdc	CGK-22-010
CR2 thru CR8	Rectifier	FBL-00-033
CR15	Not assigned	
F1	Fuse, 0.25 amperes	FFR-00-250
IC1*	Integrated circuit	FBT-00-031
Q1	Transistor, NPN	FBN-L115
Q2	Transistor, NPN	FBN-38982
R1	Res., film, 8,660 ohms ±1%, 1/4 w	DCS-87-071
R2	Res., comp., 150 ohms ±10%, 1/4 w	DCB-1511
R3	Res., comp., 120,000 ohms ±10%, 1/2 w	DEB-1241
R4	Not assigned	
R5	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R6	Res., film, 357 ohms ±1%, 1/4 w	DCR-36-043
R7	Res., ww., 4.0 ohms ±5%, 3 w	DFN-40-043
R8	Res., var., cermet, 150,000 ohms ±10%, 3/4 w	DRV-15-006
T1	Transformer	ABA-CDA-55A
*]	On units with serial no. prefixes A & B, IC1 is FBT-00-010.	

PARTS FOR MODELS

LCD-A-11 — LCD-A-55 UNIT S

- Parts for unit S are identical with
unit M parts except as follows:
1. Circuit designations are in 100
series.
 2. Rectifier CR112 is only used on
unit S. See CR1 of M unit parts
list for part identification.
 3. The parts listed below differ from
those parts used on unit M.
 4. CR111 is the same as CR1

MODEL LCD-A-12 UNIT S

C106	Cap., elect., 700 mf -10 + 100%, 20 vdc	CBR-70-071
C107	Cap., elect., 100 mf -10 + 100%, 30 vdc	CBR-10-072

MODEL LCD-A-12 UNIT S (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C111	Cap., ceramic, 680 pf ±10%, 300 vdc	CCJ-68-006
CR102 thru CR105	Rectifier	FBL-00-063
CR106	Not assigned	
CR107, CR108	Rectifier	FBL-00-030
CR115	Rectifier	FBL-00-047
F101	Fuse, 3 amperes	FFR-03-000
IC101*	Integrated circuit	FBT-00-030
R102	Res., comp., 150 ohms ±10%, 1/4 w	DCB-1511
R103	Res., comp., 1,500 ohms ±10%, 1/2 w	DEB-1521
R104	Res., ww., 1,000 ohms ±3%, 2 w	DFS-10-029
R106	Res., film, 357 ohms ±1%, 1/4 w	DCR-36-043
R107	Res., ww., 0.3 ohms ±5%, 3 w	DFM-30-053
R108	Res., var., ww or cermet, 10,000 ohms ±10%, 3/4 w	DNT-10-045
*	On units with serial no. prefixes A & B, IC101 is FBT-00-002.	

MODEL LCD-A-13 UNIT S

C106	Cap., elect., 700 mf -10 + 100%, 20 vdc	CBR-70-071
C107	Cap., elect., 100 mf -10 + 100%, 30 vdc	CBR-10-072
CR102 thru CR105	Rectifier	FBL-00-063
CR106	Not assigned	
CR107, CR108	Rectifier	FBL-00-030
CR115	Rectifier	FBL-00-047
F101	Fuse, 3 amperes	FFR-03-000
Q101	Transistor, NPN	FBN-L113
Q102	Transistor, NPN	FBN-36485
R102	Res., comp., 150 ohms ±10%, 1/4 w	DCB-1511
R103	Res., comp., 1,500 ohms ±10%, 1/2 w	DEB-1521
R104	Res., ww., 1,000 ohms ±3%, 2 w	DFS-10-029
R105	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R106	Res., comp., 357 ohms ±1%, 1/4 w	DCR-36-043
R107	Res., ww., 0.3 ohms ±5%, 3 w	DFM-30-053
R108	Res., var., ww or cermet, 10,000 ohms ±10%, 3/4 w	DNT-10-045

MODEL LCD-A-23 UNIT S

C106	Cap., elect., 350 mf -10 + 100%, 40 vdc	CBR-35-070
C107	Cap., elect., 70 mf -10 + 100%, 40 vdc	CBP-70-049
C111	Cap., ceramic, 1000 pf ±5%, 500 vdc	CCK-10-002
Q101	Transistor, NPN	FBN-L113
Q102	Transistor, NPN	FBN-36485
R103	Res., comp., 4,700 ohms ±10%, 1/2 w	DEB-4721
R104	Res., ww., 1,200 ohms ±3%, 3 w	DFS-12-016
R105	Res., comp., 470 ohms ±10%, 1/4 w	DCB-4711
R106	Res., film, 332 ohms ±1%, 1/4 w	DCR-33-042

MODEL LCD-A-23 UNIT S (Cont)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R107	Res., ww., 0.56 ohms ±5%, 3 w	DFM-56-042
R108	Res., var., ww or cermet, 23,000 ohms ±10%, 3/4 w	DNT-23-072

PARTS FOR "V" OPTION

"V" option only affects unit M models.

Transformer T1 changes on unit with "V" option. For transformer T1 used in this model see standard parts list for the standard transformer part no. and add suffix "G"* to the part no. in place of the "A" suffix.

* Suffix "V" is added to the standard part no. for units with serial no. prefixes A-C.

PARTS FOR SYSTEMS

POWER CONTROL PANEL ACCESSORY.

MODELS SP-3, SP-5

COMMON PARTS

QUANT.	DESCRIPTION	LAMBDA NO.
2	Cap., tant., 1.7 mf -15 + 75%, 150 vdc	CBN-17-031
1	Pilot light, red neon	FCA-00-013
1*	Res., comp., 47,000 ohms ±10%, 1/4 w	DCB-4731
1**	Power "ON-OFF" switch	FDA-11-001
1†	Power "ON-OFF" switch	FDA-11-022
**Used on model SP-3 only		
† Used on model SP-5 only		
*On units with "V" option this component is 150,000 ohms; Lambda no. DCB-1541		

UNIQUE PARTS

MODEL LCD-A-11

QUANT.	DESCRIPTION	LAMBDA NO.
1	Res., dual, var., cermet, 9K/9K ±10%	DRT-18-012
2	Res., meter shunt, ww., 0.05 ohms ±1%, 0.33 w	DEL-50-001
2	Res., meter multiplier, film, 10,000 ohms ±1%, 1/4 w	DCT-10-047

MODEL LCD-A-12

1	Res., dual, var., cermet, 23K/9K ±10%	DRT-32-013
1*	Res., meter shunt, ww., 0.100 ohms ±1%, 0.33 w	DEM-10-001
1**	Res., meter shunt, ww., 0.05 ohms ±1%, 0.33 w	DEL-50-001
1*	Res., meter multiplier, film, 20,000 ohms ±1%, 1/4 w	DCT-20-053
1**	Res., meter multiplier, film, 10,000 ohms ±1%, 1/4 w	DCT-10-047

MODEL LCD-A-13

1	Res., dual, var., cermet 40K/9K ±10%	DRT-49-014
1*	Res., meter shunt, ww., 0.100 ohms ±1%, 0.33 w	DEM-10-001
1**	Res., meter shunt, ww., 0.05 ohms ±1%, 0.33 w	DEL-50-001

UNIQUE PARTS (Cont)
MODEL LCD-A-13 (Cont)

QUANT.	DESCRIPTION	LAMBDA NO.
1*	Res., meter multiplier, film, DCT-50-054 49,900 ohms $\pm 1\%$, 1/4 w	
1**	Res., meter multiplier, film, DCT-10-047 10,000 ohms $\pm 1\%$, 1/4 w	

MODEL LCD-A-22

1	Res., dual, var., cermet, DRT-46-015 23K/23K $\pm 10\%$	
2	Res., meter shunt, ww., DEM-10-001 0.100 ohms $\pm 1\%$, 0.33 w	
2	Res., meter multiplier, DCT-20-053 film, 20,000 ohms $\pm 1\%$, 1/4 w	

MODEL LCD-A-23

1	Res., dual, var., cermet, DRT-63-016 40K/23K $\pm 10\%$	
2	Res., meter shunt, ww., DEM-10-001 0.100 ohms $\pm 1\%$, 0.33 w	
1*	Res., meter multiplier, DCT-50-054 film, 49,900 ohms $\pm 1\%$, 1/4 w	
1**	Res., meter multiplier, DCT-20-053 film, 20,000 ohms $\pm 1\%$ 1/4 w	

MODEL LCD-A-33

1	Res., dual, var., cermet, DRT-80-017 40K/40K $\pm 10\%$	
2	Res., meter shunt, ww., DEM-10-001 0.100 ohms $\pm 1\%$, 0.33 w	
2	Res., meter multiplier, DCT-50-054 film, 49,900 ohms $\pm 1\%$ 1/4 w	

MODEL LCD-A-44

1	Res., dual, var., comp., DMV-15-004 75K/75K $\pm 10\%$	
2	Res., meter shunt, ww., DEM-25-002 0.251 ohms $\pm 1\%$, 0.33 w	
2	Res., meter shunt, ww., DEM-25-002 0.251 ohms $\pm 1\%$, 0.33 w	
2	Res., meter multiplier, DCV-10-027 film, 100,000 ohms $\pm 1\%$, 1/4 w	

MODEL LCD-A-55

1	Res., dual, var., comp., DMV-30-005 150K/150K $\pm 10\%$	
2	Res., meter shunt, ww., DEM-51-003 0.505 ohms $\pm 1\%$, 0.33 w	
2	Res., meter multiplier, DCV-20-028 film, 200,000 ohms $\pm 1\%$, 1/4 w	

*ONLY USED ON UNIT M

**ONLY USED ON UNIT S

PARTS FOR SYSTEMS METERING
PANEL ACCESSORY, MODELS SMP-3, SMP-5

QUANT.	DESCRIPTION	LAMBDA NO.
1	Voltmeter	EBP-27-039
1	Ammeter	EDN-12-033
2	Pushbutton switch assembly	FDK-08-001
1	Selector switch, 3 pole, double throw	FDK-32-026

PARTS FOR OVERVOLTAGE
PROTECTOR ACCESSORY, MODELS
LHOV-4, LHOV-5, LHOV-6

COMMON PARTS

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., mylar, 0.01 mf $\pm 20\%$, 80 vdc	CGL-10-008
Q1	Transistor, NPN	FBN-L102
Q2	Transistor, PNP	FBN-L114
R2	Res., film, 560 ohms $\pm 2\%$, 1/2 w	DCR-56-002
R3	Res., film, 200 ohms $\pm 5\%$, 1/2 w	DCR-20-010
R4	Res., thermistor, 425 ohms, $\pm 5\%$, 1-1/4 w	DKR-43-004
R5	Res., comp., 1,200 ohms	DEB-1221
R6	$\pm 10\%$, 1/2 w	
R7	Res., comp., 33 ohms $\pm 5\%$, 1/4 w	DCB-3305
R8	Res., comp., 15,000 ohms $\pm 10\%$, 1/2 w	DEB-1531
R9	Res., comp., 22 ohms $\pm 10\%$, 1/2 w	DEB-2201
R10	Same as R5	
SCR1	Rectifier, silicon controlled	FBP-00-009

UNIQUE PARTS

MODEL LHOV-4

R1	Res., var., ww or cermet, DNT-10-045 10,000 ohms $\pm 10\%$, 1 w	
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MODEL LHOV-5

R1	Res., var., ww or cermet, DNT-20-010 20,000 ohms $\pm 10\%$, 1 w	
----	--	--

MODEL LHOV-6

R1	Res., var., ww., 30,000 ohms $\pm 10\%$, 1 w	DNT-30-027
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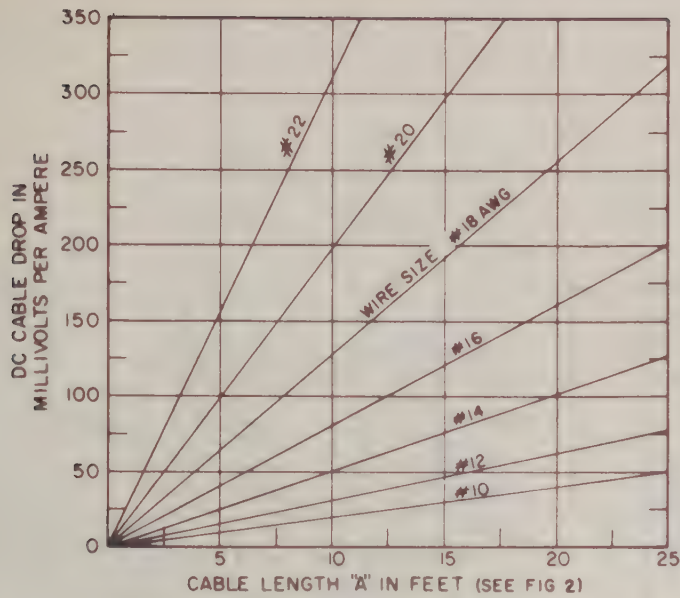


Figure 1. Cable Connection Chart

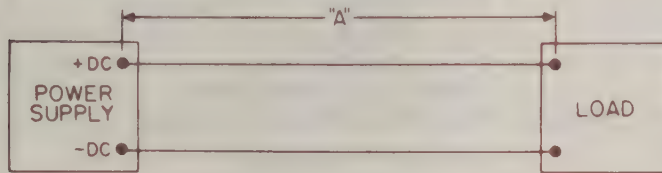
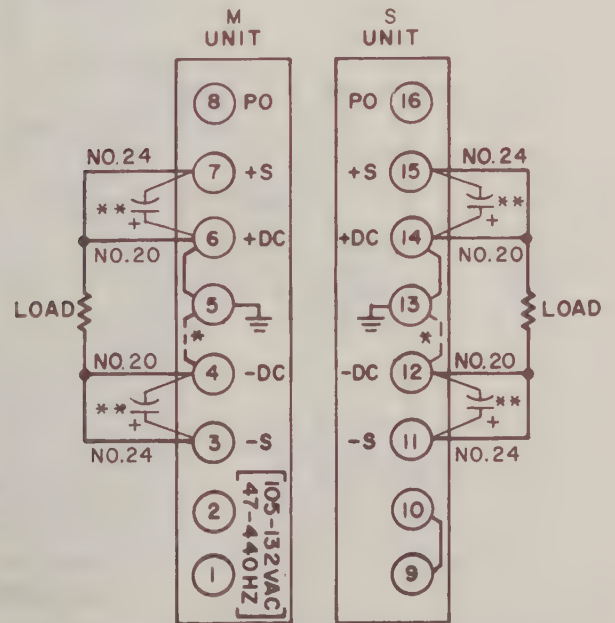
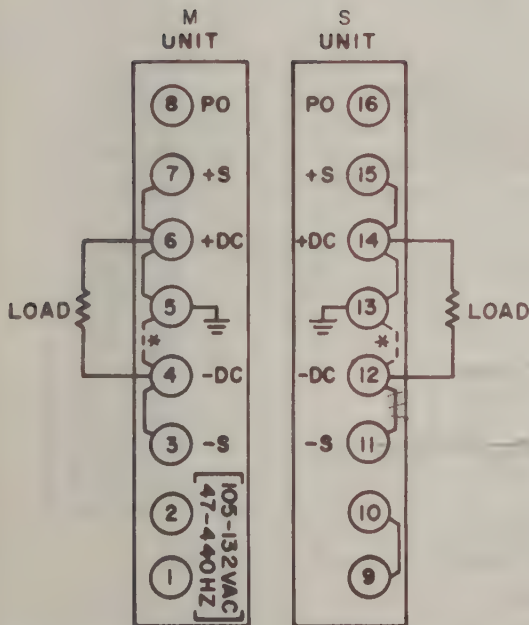


Figure 2. Cable Length "A" in Feet

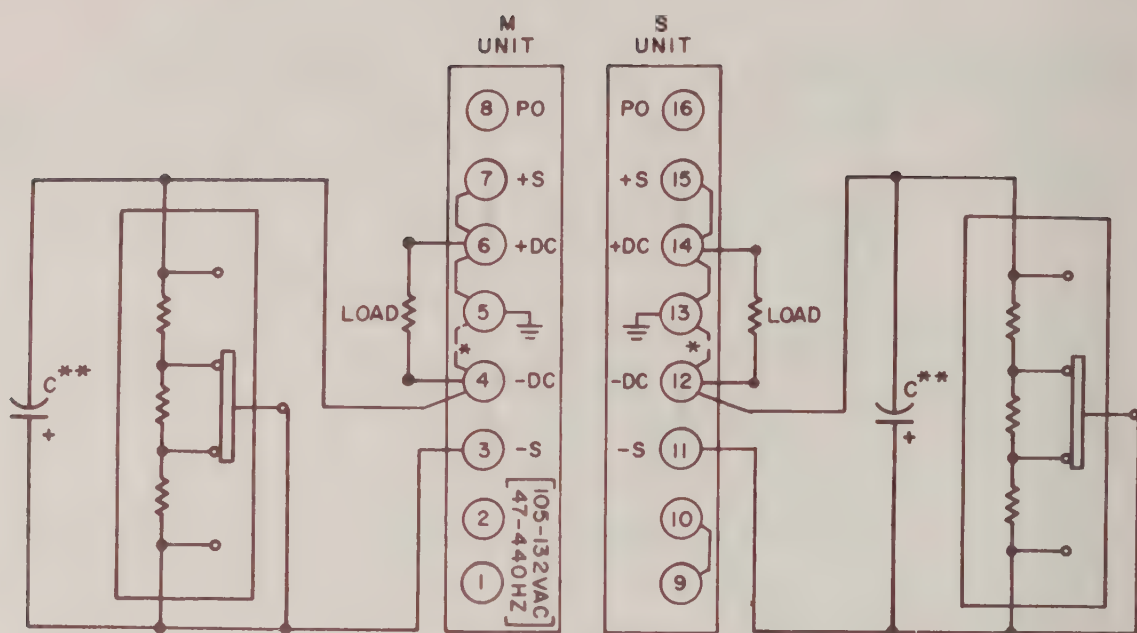


* FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 5-6, 13-14 AND RECONNECT TO TERMINALS 5-4, 12-13.

Figure 3. Two-Wire Connection

* FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 5-6, 13-14 AND RECONNECT TO TERMINALS 5-4, 12-13.
** A 2.5MF, ELECT. CAP. MAY BE REQUIRED.

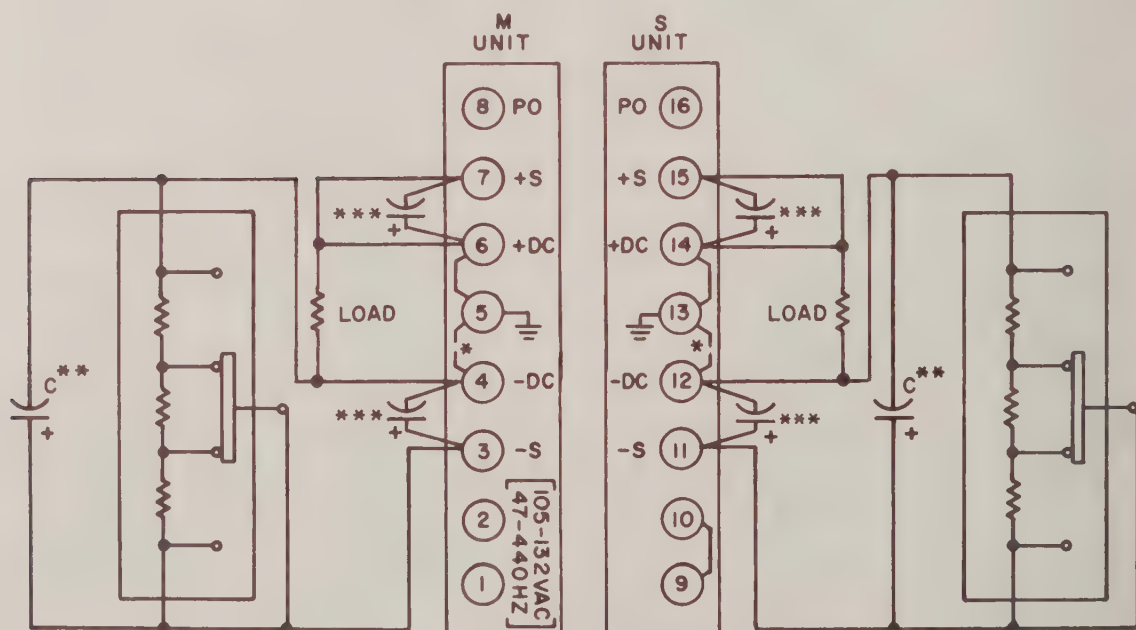
Figure 4. Four-Wire Connection



PROG. RES. = $1000\Omega/\text{VOLT}$

NOTE: OUTPUT VOLTAGE CONTROLS MUST BE SET TO ZERO.

(A) LOCAL SENSING



PROG. RES. = $1000\Omega/\text{VOLT}$

NOTE: OUTPUT VOLTAGE CONTROLS MUST BE SET TO ZERO

(B) REMOTE SENSING

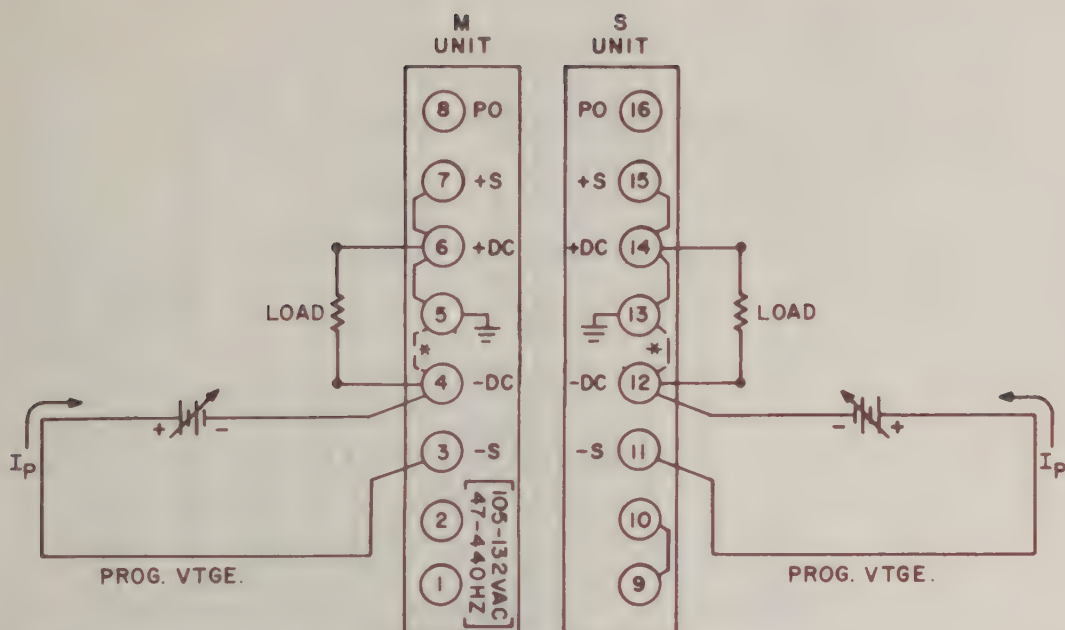
*FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 5-6, 13-14 AND RECONNECT TO TERMINALS 5-4, 12-13.

**C = 2.5 MFD, 200V FOR MODELS LCD-A-11, THRU LCD-A-44

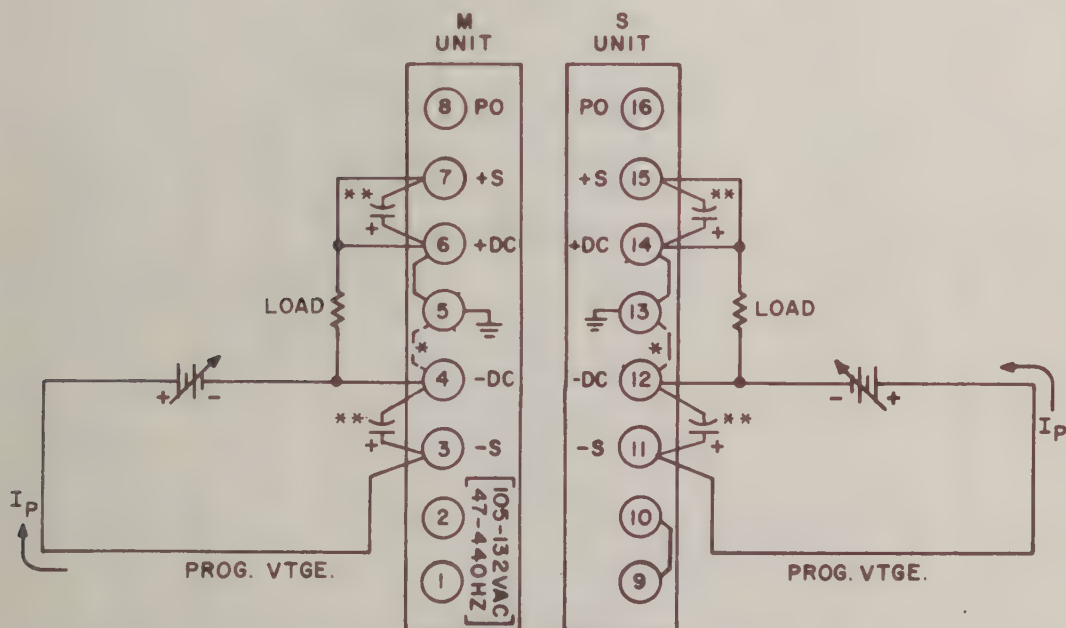
C = 1.4 MFD, 400V FOR MODEL LCD-A-55.

***A 2.5MF, ELECT., CAP., MAY BE REQUIRED.

Figure 5. Programmed Voltage, With External Resistor



NOTE: OUTPUT VOLTAGE CONTROLS MUST BE SET TO ZERO
(A) LOCAL SENSING

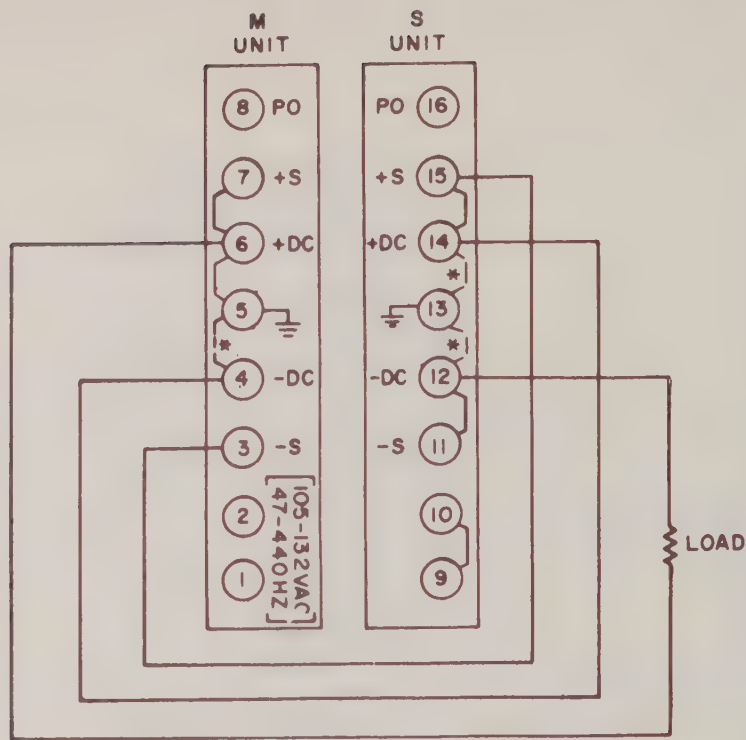


NOTE: OUTPUT VOLTAGE CONTROLS MUST BE SET TO ZERO.
(B) REMOTE SENSING

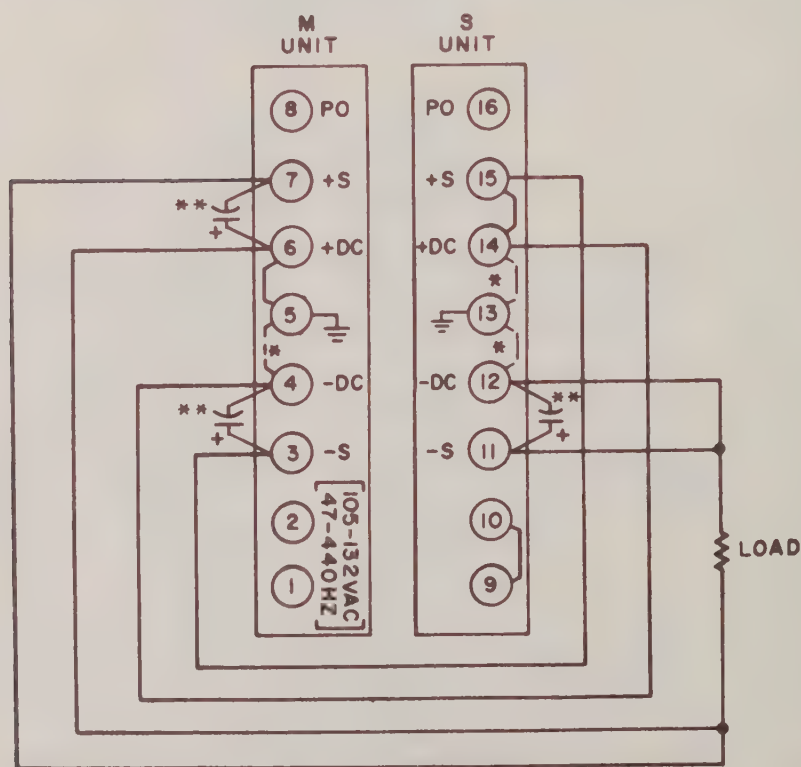
* FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 5-6, 13-14, AND RECONNECT TO TERMINALS 5-4, 12-13.

** A 2.5MF, ELECT., CAP., MAY BE REQUIRED.

Figure 6. Programmed Voltage, With External Programming Voltage Source



(A) LOCAL SENSING

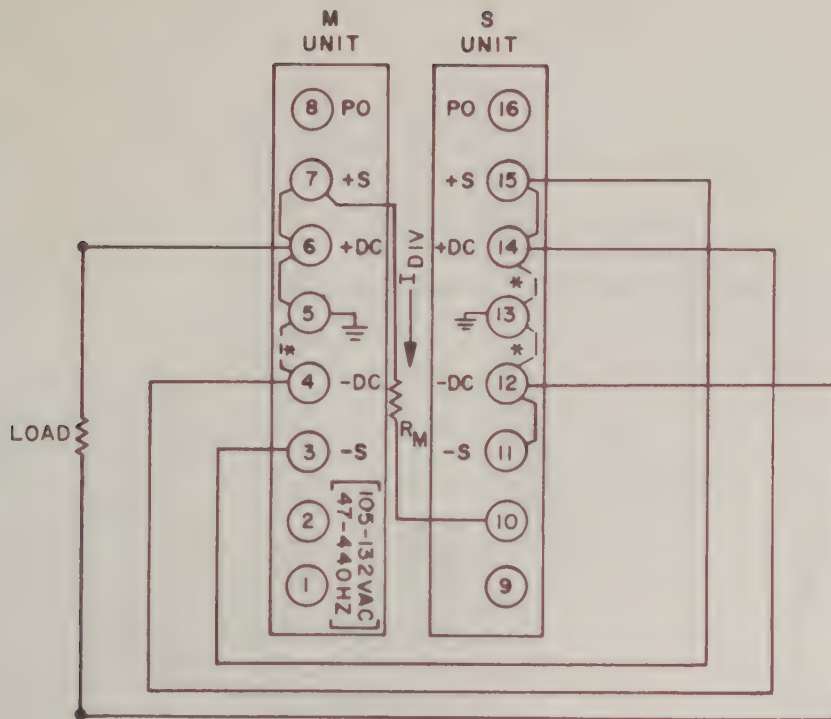


(B) REMOTE SENSING

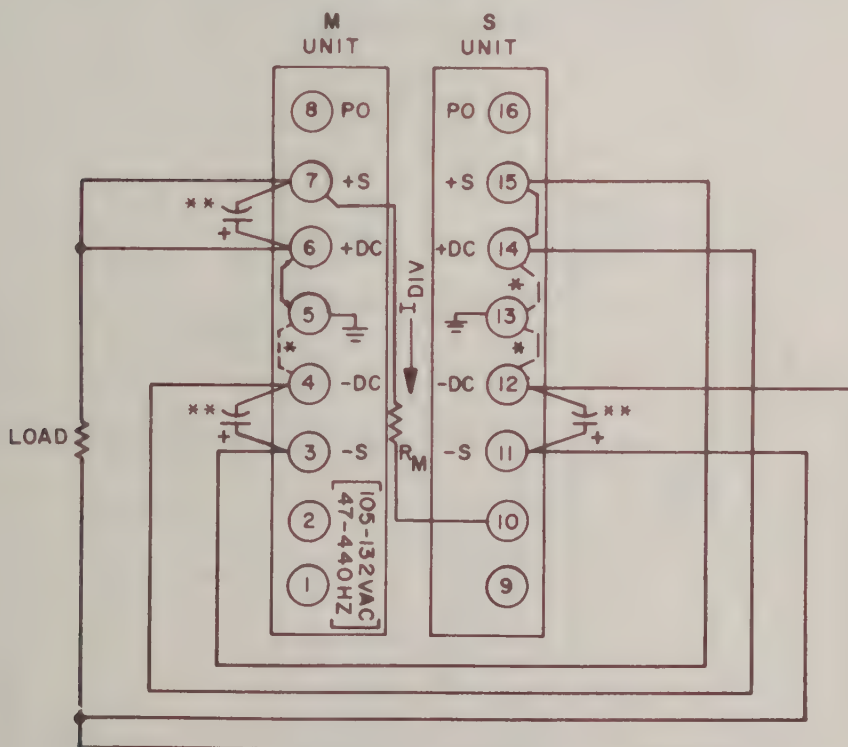
***MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.**

**** A 2.5MF, ELECT., CAP., MAY BE REQUIRED.**

Figure 7. Series Connection



(A) LOCAL SENSING



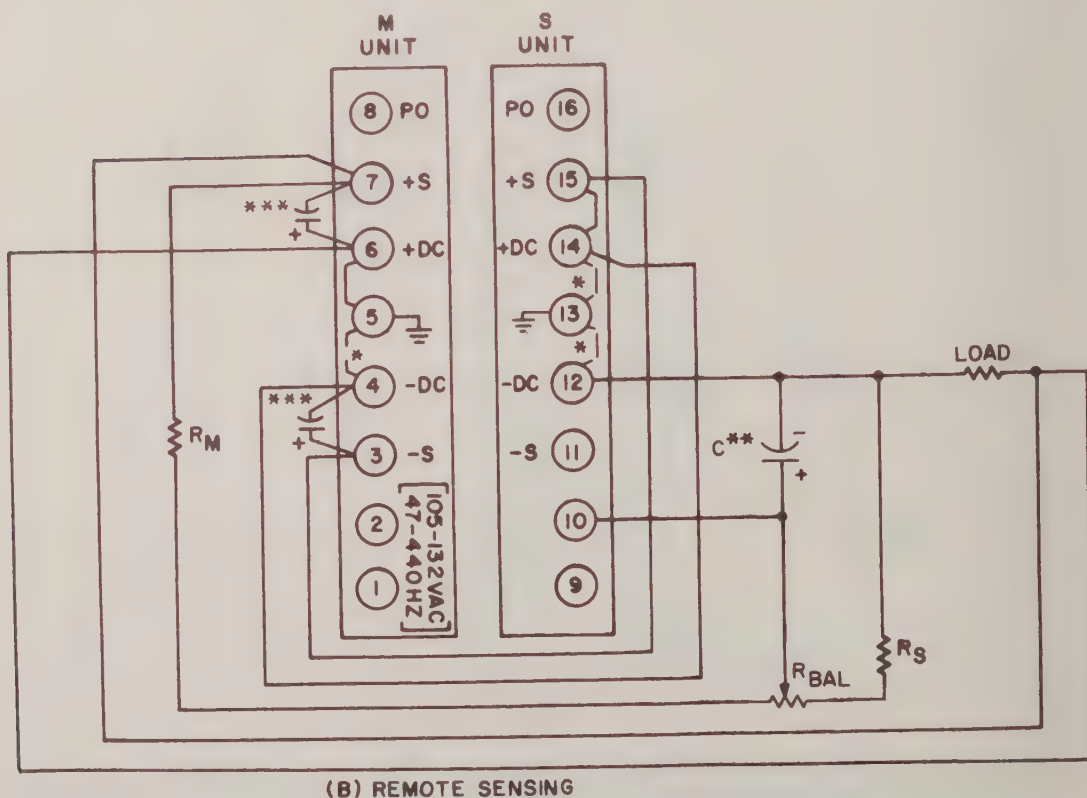
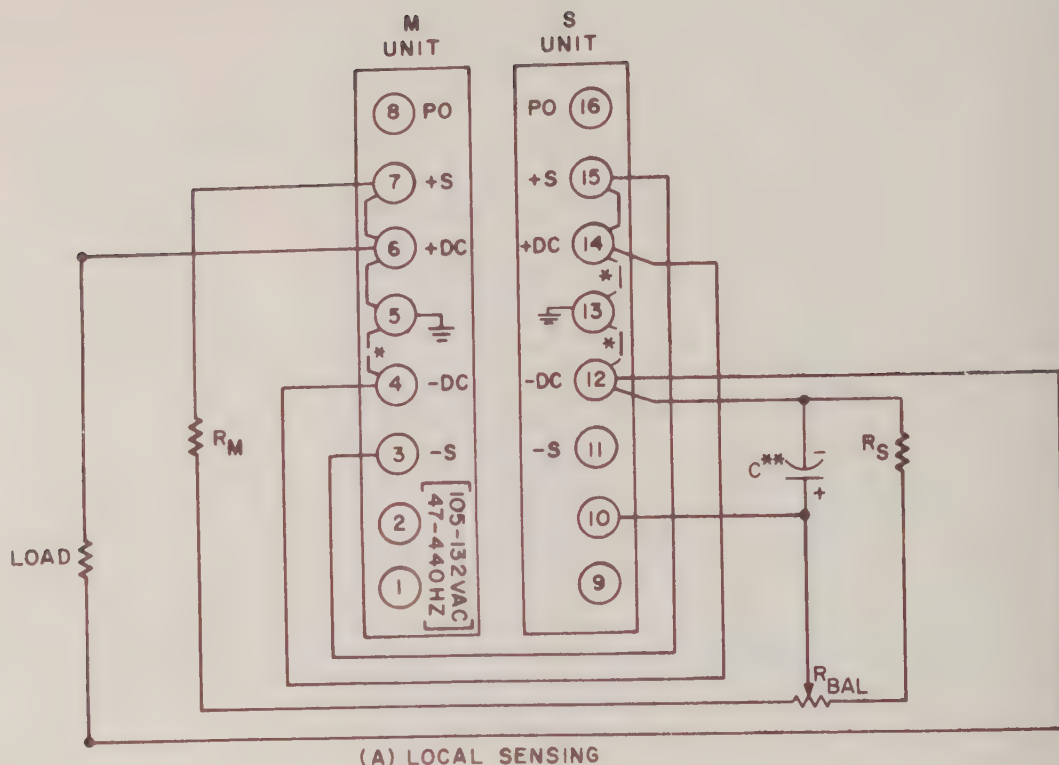
(B) REMOTE SENSING

* MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5MF, ELECT. CAP. MAY BE REQUIRED.

NOTE: ONLY USE "M" UNIT OUTPUT VOLTAGE CONTROL TO CONTROL OUTPUT OF THE SERIES COMBINATION.

Figure 8. Auto-Series Connection



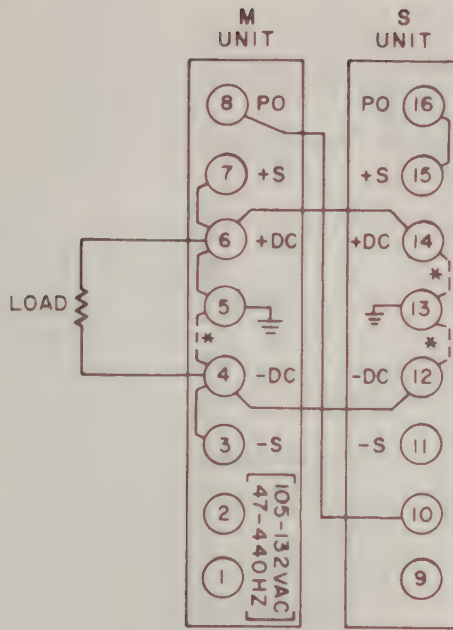
* MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

**C = 2.5MFD, 200V FOR MODELS LCD-A-11 THROUGH LCD-A-44

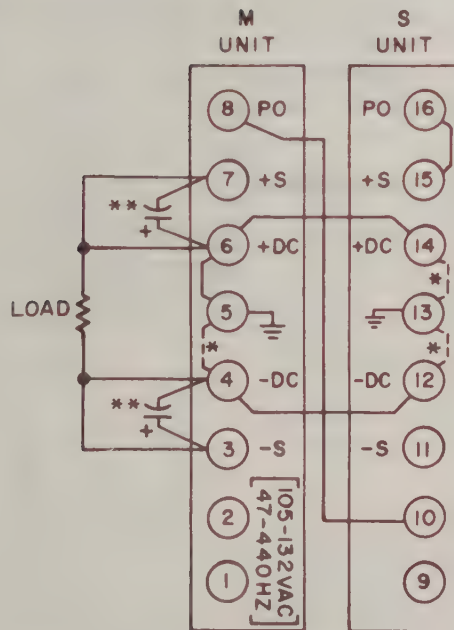
C = 1.4 MFD, 400V FOR MODEL LCD-A-55

***A 2.5MF, ELECT., CAP., MAY BE REQUIRED

Figure 9. Alternate Auto-Series Connection



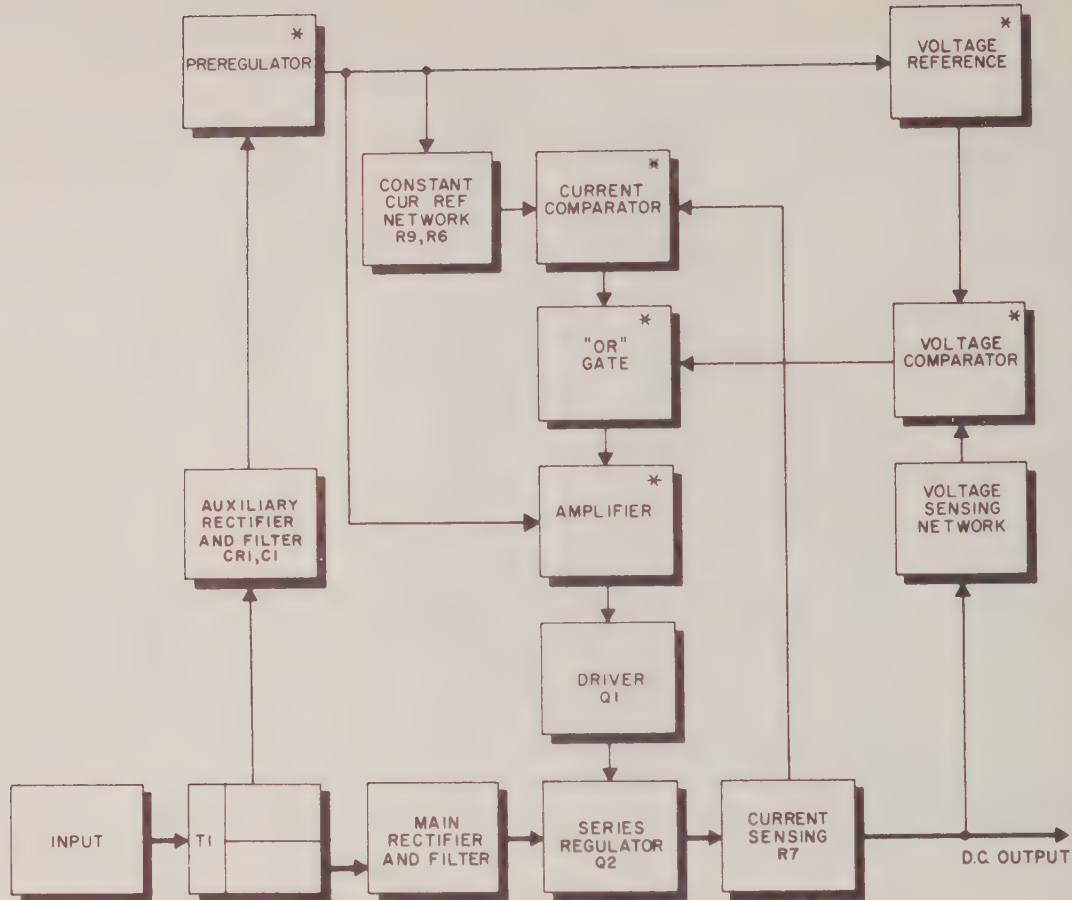
(A) LOCAL SENSING



(B) REMOTE SENSING

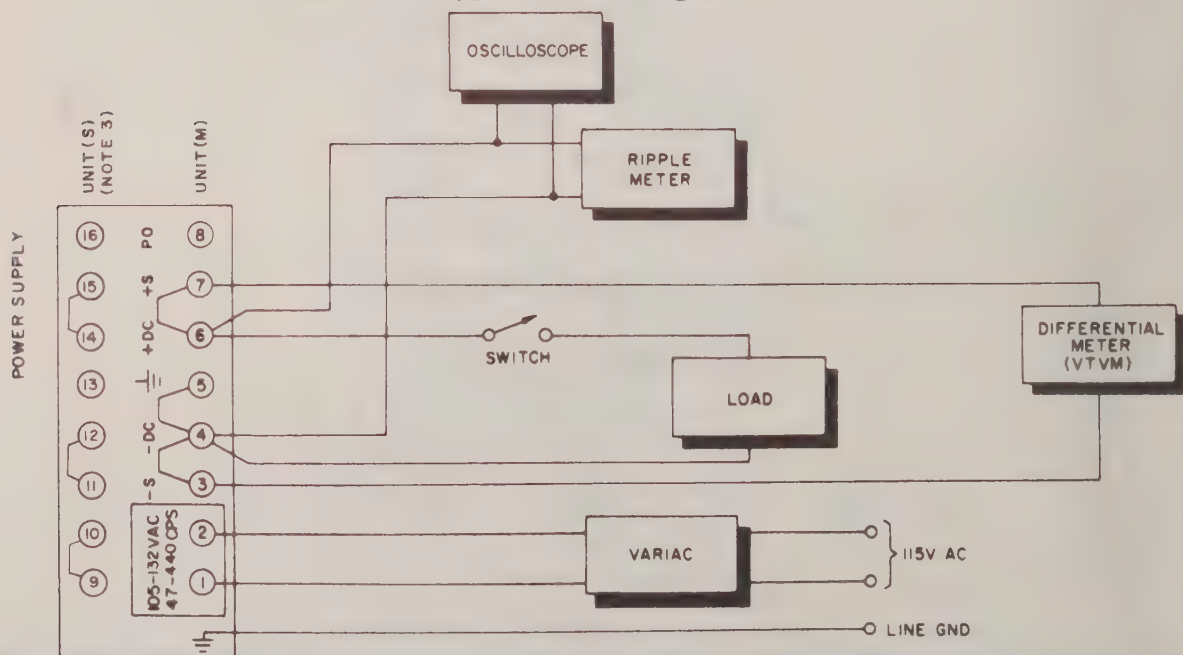
- * MAKE ONLY ONE GROUND CONNECTION FOR EACH PARALLEL COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON "M" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.
- ** A 2.5MF, ELECT., CAP., MAY BE REQUIRED.

Figure 10. Parallel Connection



NOTE: THIS DIAGRAM APPLIES TO UNIT(S) EXCEPT INPUT BLOCK AND T1 PRIMARY ARE NOT USED AND CIRCUIT DESIGNATION NUMBERS ARE IN THE 100 SERIES.
 *THIS CIRCUIT ELEMENT IS LOCATED IN IC1.

Figure 11. Typical Block Diagram



NOTES

- 1 REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE LINE CORD TO GROUND
- 2 PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY
- 3 WHEN CHECKING UNIT(S) CONNECT TO UNIT(S) TERMINALS AND ADD JUMPERS AS SHOWN; AC INPUT STILL CONNECTS TO TERMINALS 1 AND 2; TERMINAL 12 CONNECTS TO TERMINAL 50R13.

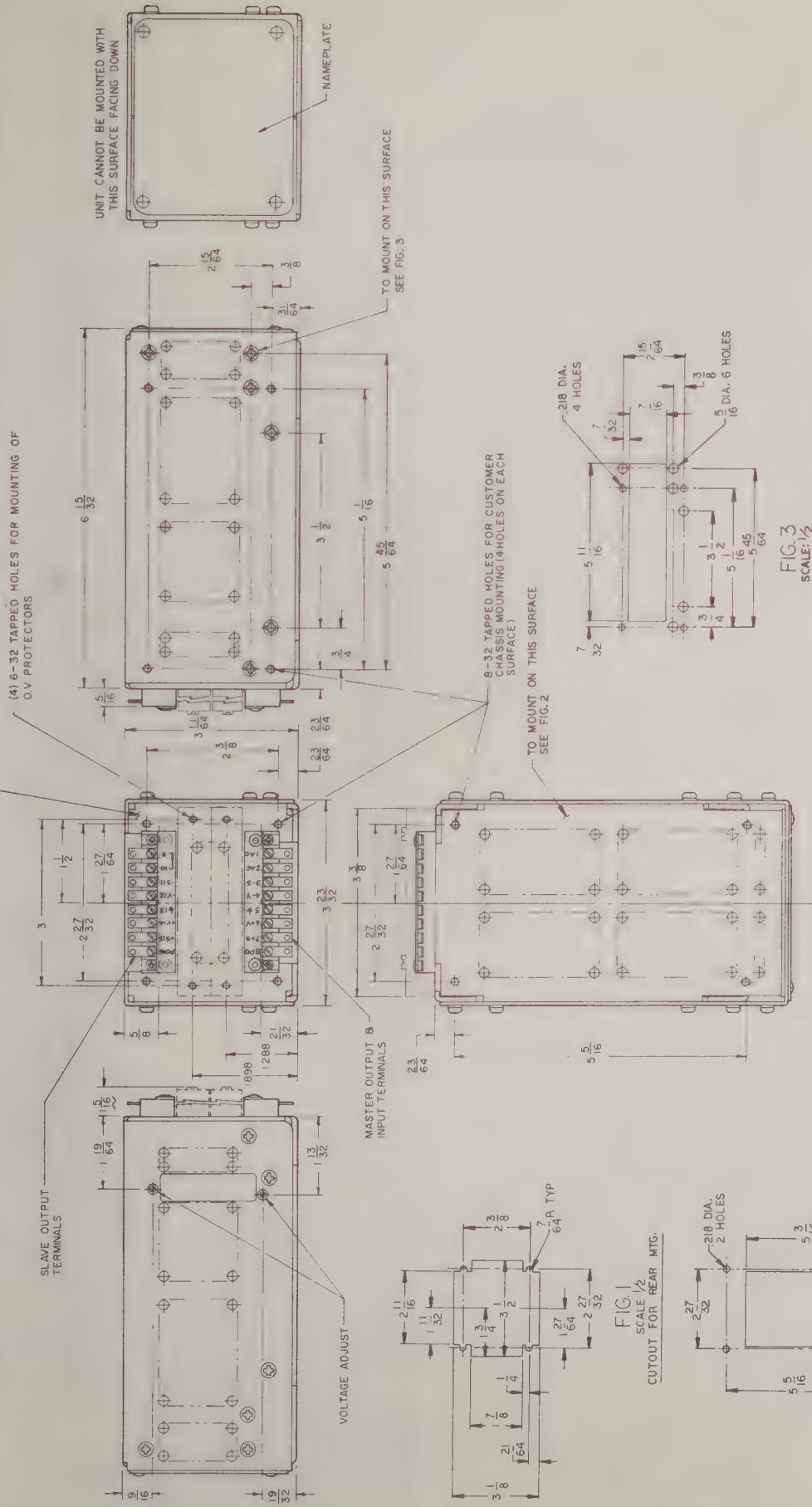
Figure 12. Test Connections For Constant Voltage Performance Checks

RIGHT SIDE VIEW

REAR VIEW

LEFT SIDE VIEW

FRONT VIEW



BOTTOM VIEW

NOTE

1. CUSTOMERS MOUNTING SCREWS MUST NOT PROTRUDE INTO POWER SUPPLY BY MORE THAN 3/8".

2. CUSTOMER MUST PROVIDE CUT-OUTS IN HIS MOUNTING SURFACE TO CLEAR VENTILATION PATTERNS AND ALLOW FREE AIR CIRCULATION.

FIG. 3
SCALE: 1/2
CUTOUT FOR LEFT SIDE MTG.

FIG. 1
SCALE: 1/2
CUTOUT FOR REAR MTG.

FIG. 2
SCALE: 1/2
CUTOUT FOR BOTTOM MTG.

Figure 13. Typical Outline Drawing

TABLE I
DATA REFERENCES FOR MODELS
LCD-A-11 - LCD-A-55
"M" AND "S" UNITS[†]

Model	Schematic Voltage Measurements				Schematic Components																		
	A (VDC)	B (VDC)	C (VDC)	D (VAC)	C5 -10% MYLAR	C6 -10 +100% ELECT.	C7 -10 +100% ELECT.	C11 CERAMIC	C15 +10% MYLAR	CR2-CR5 *FBL-00- 083	**CR6 *FBL-00- Not used	CR7-CR8 *FBL-00- 030	*CR15 *FBL-00- (AMP) 3	Q1 L113	Q2 *FBN- 36485	R2 ±10%, 1/4W COMP.	R3 ±10%, 1/2W COMP.	R4 ±3% WW 2W	R5 ±10%, 1/4W COMP.	R6 ±1%, 1/4W FILM 357	R7 3W WW ±5%	R8 ±10%, 3/4W WW or CERMET 23,000 or CERMET 40,000 or CERMET 40,000	
LCD-A-11	-7.0	16.8	-7.6	17.3	0.068 mF 200V	700 mF 20V	100 mF 30V	680 pF ±10% 300V	0.01 mF 200V	083	Not used	030	047	3	L113	36485	150	1,500	1,000 2W	470	357	0.3 ±5%	10,000 WW or CERMET
LCD-A-12	-18.0	21.1	-18.6	27.5	0.068 mF 200V	350 mF 40V	70 mF 40V	1000 pF ±5% 500V	0.01 mF 200V	030	030	030	Not used	1.5	L113	36485	330	4,700	1,200 3W	470	332	0.56 ±5%	23,000 WW or CERMET
LCD-A-13	-32.0	26.7	-32.6	42.0	0.068 mF 200V	250 mF 30V	40 mF 60V	680 pF ±10% 300V	0.01 mF 200V	030	030	030	Not used	1.5	L109	36220	330	10,000	2,500 3W	820	374	0.91 ±2%	40,000 CERMET
LCD-A-22	-18.0	21.1	-18.6	27.5	0.068 mF 200V	350 mF 40V	70 mF 40V	680 pF ±10% 300V	0.01 mF 200V	030	030	030	Not used	1.5	L109	36485	220	4,700	1,200 3W	470	332	0.56 ±5%	23,000 or CERMET
LCD-A-23	-32.0	26.7	-32.6	42.0	0.068 mF 200V	250 mF 30V	40 mF 60V	680 pF ±10% 300V	0.01 mF 200V	030	030	030	Not used	1.5	L109	36220	330	10,000	2,500 3W	820	374	0.91 ±2%	40,000 or CERMET
LCD-A-33	-32.0	26.7	-32.6	42.0	0.068 mF 200V	250 mF 30V	40 mF 60V	680 pF ±10% 300V	0.01 mF 200V	030	030	030	Not used	1.5	L109	36220	330	10,000	2,500 3W	820	374	0.91 ±2%	40,000 or CERMET
LCD-A-44	-60.0	46.4	-60.6	77.0	0.015 mF 400V	88 mF 100V	12 mF 150V	1000 pF ±5% 500V	0.01 mF 200V	036	036	036	Not used	0.75	L108	35902	330	33,000	3,600 3W	470	357	1.5 ±2%	75,000 CERMET
LCD-A-55	-120.0	58.5	-120.6	127.0	0.015 mF 400V	40 mF 250V	8 mF 200V	680 pF ±10% 300V	0.0022 mF 400V	033	033	033	Not used	0.25	L115	36982	150	120,000	Not used	470	357	4.0 ±5%	150,000 CERMET

Lambda part number

* Lambda part number

** CR15 replaces CR6 on LCD-A-11 master unit.

† "g" unit circuit designation are in the 180 series. Parts and voltages for the "g" unit are identical to those of the "M" unit except as follows:

Model	Schematic Voltage Measurements				Schematic Components																
	A (VDC)	B (VDC)	C (VDC)	D (VAC)	C106 -10 +100% ELECT.	C107 ELECT.	C111 CERAMIC	CR102- CR105 *FBL-00- 063	††CR106 *FBL-00- Not used	††CR115 *FBL-00- 047	F101 (AMP)	Q101 *FBN- L113	Q102 *FBN- 36485	R102 ±10%, 1/4W COMP.	R103 ±10%, 1/2W COMP.	R104 ±3% WW 2W	R105 ±10%, 1/4W COMP.	R106 1%, 1/4W FILM COMP.	R107 3W ±5%	R108 3W ±10%, 3/4W CERMET	
LCD-A-11	-7.0	16.8	-7.6	17.3	700 mF 20V	100 mF 30V	680 pF ±10% 300V	063	Not used	047	3.0	L113	36485	150	1,500	1,000 2W	357	470	357	0.3 ±5%	10,000 WW or CERMET
LCD-A-12	-7.0	16.8	-7.6	17.3	700 mF 20V	100 mF 30V	680 pF ±10% 300V	063	Not used	047	3.0	L113	36485	150	1,500	1,000 2W	357	470	357	0.3 ±5%	10,000 WW or CERMET
LCD-A-13	-7.0	16.8	-7.6	17.3	700 mF 20V	100 mF 30V	680 pF ±10% 300V	063	Not used	047	3.0	L113	36485	150	1,500	1,000 2W	357	470	357	0.3 ±5%	10,000 WW or CERMET
LCD-A-22	-18.0	21.1	-18.6	27.5	350 mF 40V	70 mF 40V	680 pF ±10% 300V	030	030	Not used	1.5	L109	36485	220	4,700	1,200 3W	470	332	0.56 ±5%	23,000 WW or CERMET	
LCD-A-23	-18.0	21.1	-18.6	27.5	350 mF 40V	70 mF 40V	680 pF ±10% 300V	030	030	Not used	1.5	L113	36485	330	4,700	1,200 3W	470	332	0.56 ±5%	23,000 WW or CERMET	
LCD-A-33	-32.0	26.7	-32.6	42.0	250 mF 50V	40 mF 80V	680 pF ±10% 300V	030	030	Not used	1.5	L109	36220	330	10,000 3W	2,500 3W	374	320	0.91 ±2%	40,000 CERMET	
LCD-A-44	-60.0	46.4	-60.6	77.0	88 mF 100V	12 mF 150V	1000 pF ±5% 500V	036	036	Not used	0.75	L108	35902	220	33,000 3W	3,600 3W	470	357	1.5 ±2%	75,000 CERMET	
LCD-A-55	-120.0	58.5	-120.6	127.0	40 mF 250V	8 mF 200V	680 pF ±10% 300V	033	033	Not used	0.25	L115	38982	150	120,000	Not used	470	357	4.0 ±5%	150,000 CERMET	

* Lambda part number

†† CR115 replaces CR106 on LCD-A-12, -13 slave units.



5 - Year Guarantee

We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.

We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

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